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[Title of the Invention]: **Warp-Knitting Machine**

Brief Description of the Drawings

Fig. 1 is a front view of a sinker related to the present invention; Fig. 2 is a perspective view showing sinker assemblies configured with sinkers fixed facing each other, as well as a knitting needle and a guide for a warp-knitting machine that works in cooperation with the sinker assemblies; and Fig. 3 is a perspective view depicting the operation of the sinkers related to the present invention.

Detailed Description of the Invention

The present invention relates to a sinker for a warp-knitting machine. The warp-knitting machine has a reciprocating group of needles with one row of hooks, and has one row or a plurality of rows of warp yarn guide-hole clasps that reciprocate back and forth across the row of needles.

Sinkers are disposed between the needles to form one row, the sinkers have nose tips, and all of the sinkers move forward and backward to cause the nose tips to enter into and out of the space between the needles for each knit operation.

When fabric with a single type of stitch is knitted with a knitting machine such that the chain stitch of an open loop is formed, in other words, when openwork fabric is knitted, one row or a plurality of rows of guide-hole clasps must be swung so as to reciprocate back and forth

across the same knitting needles by the continuous knitting action of the clasps. At this time, the warp yarn does not move across either of the adjacent sinkers, so no ridges are formed in the chain stitch yarn in the vicinity of the nose tips of the sinkers. Loops formed in the vicinity of the needles are furthermore not effectively removed when the needles rise from between the sinkers.

Achieving the above-stated object with a conventional knitting machine was made possible by using an added swinging warp yarn distributor, that is, a point divider, which is the same as that used in early Milanese machines produced in the United Kingdom. The warp yarn is displaced along the knitting needle row by the point divider in the Milanese machine.

According to the present invention, a sinker for a warp-knitting machine has one nose tip, the protruding portion of the nose tip is partially separated into two portions, and the separated two portions are set facing each other and are made to diverge toward the nose tip of another sinker.

One portion of each of the nose tips may be flat, and may be in the same plane as the sinker. The other portion may form an angle with respect to the plane, and the two portions may alternately diverge at the same angle with respect to the center plane that contains the sinker.

When sinkers such as those described above are attached to the knitting machine and the nose tips of the sinkers are disposed between the knitting needles, the diverging portion of the nose tips extend behind the knitting needle shafts, that is, to the side without the needle hook. The two portions of the nose tips mutually diverge across a distance equal to the distance between the adjacent sinkers. As a result, a portion of the nose tip of one sinker passes through the center line of the reciprocating needle, and makes contact with one portion of the nose tips of other adjacent sinkers in a plane perpendicular to the row of needles. With such a configuration, the needles pass by the diverging portion when the nose tips descend from between the needles because the diverging portion of the nose tip is flexible, so the nose tips can be separated when in a state of contact.

The sinkers may be formed with two flexible plates fixed facing each other. Protrusions are provided to the two flexible plates, and the leading ends of the protrusions are mutually bent and separated. In common practice, the sinkers are mutually separated and fixed to a sinker rod. The sinker rod to which a group of sinkers is attached is a sinker assembly that can be incorporated into a knitting machine.

Known knitting machine elements and drive source mechanisms can be used for the knitting machine into which the sinker related to the present invention is incorporated.

The present invention is described below with reference to the diagrams using a working example. Each sinker comprises two flat plates 1 and 2, each having protruding portions 3 and 4 on the upper edge of the sinker, where a single nose tip is formed. Each of the leading edges 5 and 6 of the protruding portions 3 and 4, which are extensions from the neck portion 7 of the sinker, mutually diverge and separate, as is apparent from Figs. 2 and 3. The row of sinkers is formed by fixing the trailing edge portion 8 of each of the sinkers in sequence to a light metal block 9. Holes are provided to the flat plates 1 and 2, as shown in by the key numbers 10 to 13. The sinkers are tightly fixed to the block 9 by means of the holes 10 and 11. The hole 12 acts solely to hold the sinker when attaching the sinker to the block 9; and a round bar 14 (shown by the dotted-line in Fig. 2) is passed completely through the holes 13, as shown in Fig. 3, and holds the separation between the front end portions 15 of the sinker steady. The block 9 is aligned and fixed to the sinker rods.

Each sinker comprising the two flat plates 1 and 2 is attached between needles 16 of the warp-knitting machine. The needles 16 are well known in the art and have tongues 18 that are disposed within the tube-shaped shaft of the needles 16 and the hooks 17, and that reciprocate so as to open and close the hooks 17. The warp-knitting machine has a single row or a plurality of rows of guide-hole clasps, and the key number 19 is shown as one row thereof.

When the knitting machine is in operation, the needles 16 reciprocate in the vertical direction of the arrow 20. The clasps 19 reciprocate in the direction of the arrow 21, and reciprocate along the row of needles 16, as indicated by the arrow 22. The group of sinkers reciprocates in the direction of the arrow 23. Warp yarn drawn out from the warp bundle passes completely through the openings 24 of the guide-hole clasps 19.

Fig. 3 depicts an operation in which openwork fabric having a certain stitch is knitted with a knitting machine such that the chain stitch of an open loop is formed. In Fig. 3, continuous stitch loops 26, 27, and 28 are knitted with the same needle using one warp yarn 25. The pattern mechanism is controlled to cause the guide-hole clasps 19 to reciprocate along the direction of the needle row and to move back and forth across the neck of a single needle in order to knit such stitch loops. When the above-described knitting operation is performed in conventional knitting machines that use a sinker assembly composed of sinkers that have only

one nose tip in the same plane as the sinker plate disposed between the needles, the warp yarn does not pass under any of the sinker nose tips, and, as a result, the knitted loops do not sufficiently descend when the needles rise. However, if the sinker having two nose tips related to the present invention is used, the above-noted drawback can be eliminated. The method by which a loop is knitted under the nose tip of the sinker is shown in Fig. 3. Fig. 3 shows in detail the above-described knitting operation, and depicts one sinker having two nose tips that are fixed in a set position for descriptive purposes.

Six continuous operation steps are shown in six different positions in one knitting cycle of a clasp needle for knitting stitch loops. It is apparent that in an actual knitting operation the needle reciprocates up and down, and the sinker reciprocates horizontally. For the sake of convenience, however, the needle is shown moving in the upward and rightward directions, because the sinker, which has the same size but the opposite movement direction, moves toward the needle. The guide clasp needles can also be shown in six continuous positions relative to the movement of the needle. The positions of the needle and the guide-hole clasp in six continuous steps are indicated by the keys A to F.

Both the hook 17 of the needle and the hole clasp 19 in the first step of a knitting cycle are in the position indicated by A. The warp yarn 25 goes completely through the opening 24, passes inside the loop 27 in engagement with the knitting needle 16 in the knitting cycle previous to the current knitting cycle, and further connects to the previously obtained knitted fabric in engagement with the hook 17. The hook 17 in this step is completely closed by the tongue 18. In step B, the hook 17 begins to rise, the tongue 18 operates so as to open the hook 17, and the sinker comprising the flat plates 1 and 2 moves slightly to the left. Describing this movement with regard to Fig. 3, this is equivalent to the relative movement in the rightward direction of the needle. The guide 19 also moves to the left. The hook 17, guide-hole clasp 19, and sinker flat plates 1 and 2 then move to step C. In this step, the knitting plate¹ 25 passes completely through to the underside portion of the loop 27 that is protruding in the rightward direction, and appears at this time to the left side of the right-hand ridge 29 of the leading end 5 on the flat plate 1 that forms the nose tip portion. At this point, the knitting needle² 25 passes by the back surface of the leading end 5, travels underneath the leading end 5, and appears on the front surface of the flat

¹ Should probably read "warp yarn"

² Should probably read "warp yarn"

plate 1. In step D of the knitting operation, the hook 17 is opened because the tongue 18 withdraws completely into the tubular shaft of the needle 16, and the needle rises in relation to the sinker formed by the guide-hole clasp 19 and the flat plates 1 and 2. The loop 28 already in engagement with the hook 17 descends around the shaft of the needle 16. The loop descends because the warp yarn 25 engages to the neck portion 7 of the sinker due to the fact that the warp yarn 25 passes by the back surface of the leading end 5. At this point, the needle rises from the position indicated by E to the position indicated by F, which is the maximum rise position, and the guide-hole clasp 19' swings to the rightmost edge of Fig. 3. This rightmost edge is similarly indicated by the key F. Furthermore, the guide-hole clasp 19 in this step moves to the position shown by the dotted line 19' in Fig. 3. The purpose of this movement is to wind the warp yarn 16 in vine-like fashion in the vicinity of the neck of the needle 16. The warp yarn 25 is connected to the back surface of the leading end 5 of the flat plate 1, so the warp yarn in this vine-form winding is present only from the upper edge 30 of the flat plate 1 to the upper portion. If the warp yarn 25 were not caused to pass by the back surface of the leading end 5, then the warp yarn wound in a vine-like fashion would begin from the knitted loop 27' that was previously knitted. By modifying the starting point for the warp yarn wound in a vine-like fashion in such a manner, it is possible to cause the vine-form warp yarn to engage the needle hook at a vine-like angle that is more shallow in relation to the needle shaft than that of a warp yarn directly wound in a vine-like fashion from the fabric in a previous step.

The ability to make the vine-like angle of the warp yarn shallow in such a manner is very advantageous. The reason is that the warp yarn can be caused to engage the needle hook more rapidly than in the prior art, and that knitting errors can be prevented. Therefore, the sinker related to the present invention is particularly advantageous when performing decorative knitting with a knitting needle that has a single knitted chain loop. The reason is that the knitted loop is allowed to descend on the ridge formed at the portion where the nose tip of the sinker is separated. This is further advantageous when the sinker related to the present invention knits a stitch in any other form by means of the reciprocating movement of the guide between continuous stitches knitted with a plurality of needles. The reason is that warp yarn wound in a vine-like fashion around the needle shaft as described above is allowed to come into more proximate contact with needle hook in comparison with that used in a conventional sinker.

In particular, the above stated facts are important in a knitting machine having guide-hole clasps formed in three rows or more. This is because when the guide swings on the front surface of the needle hook, the outermost row of the guide-hole clasps, that is, the row of guide-hole clasps furthest separated from the needle hooks, must be significantly separated from the needle hooks, and the portion in which the warp yarn is wound in a vine-like fashion does not begin from the shaft of the needle, even if the warp yarn is thereby extended at an oblique angle from the hook.

A sinker ridge is formed on the warp yarn 25, which is below the leading end 5 in the steps in which the knitting operation moves from the A to F positions; and the needle 16 thereafter descends as described above. The hook 17 of the needle is then closed again by the tongue 18 at this time. When the needle begins to descend, the sinker moves to the right and the hook 17 passes between the leading ends 5 and 6 of the mutually proximate sinkers. The leading ends 5 and 6 are mutually separated so as to allow the hook 17 to move.

It is apparent that the new loop of warp yarn 25 in engagement with the hook 17 in step F of the knitting operation also passes between the leading ends 5 and 6 because of the movement of the hook 17. Because the needle descends, the knitted loop 28 in the previous knitting operation enters the hook 17, and the needle returns to the position indicated by A. The difference between the knitting described above and a conventional knitting machine with one nose tip is solely related to the fact that there is only one nose tip. If a conventional sinker having only one nose tip is used, the warp yarn does not pass by the back surface of the leading end 5 when the needle rises between the positions A and C, and the leading end passes by the front surface of the leading end because this end is present only in the same plane as the flat plates 1 and 2. No ridge is formed below the nose tip of the sinker; and when the needle rises to the positions indicated by E and F, the loop 28 formed around the needle is allowed to rise again. The rising of this loop causes critical knitting errors when fabric having chain stitches with open loops is knitted in a conventional knitting machine.

Claims

1. A sinker for a knitting machine, characterized in that a single nose tip is provided, the portion extending beyond the neck portion of the nose tip branches into two parts, and the portions branched into two parts face each other and mutually diverge in the direction of the nose tips of other sinkers, as described in the specification above.

Fig. 1

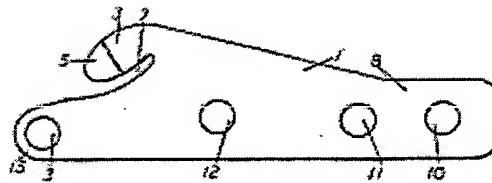


Fig. 2

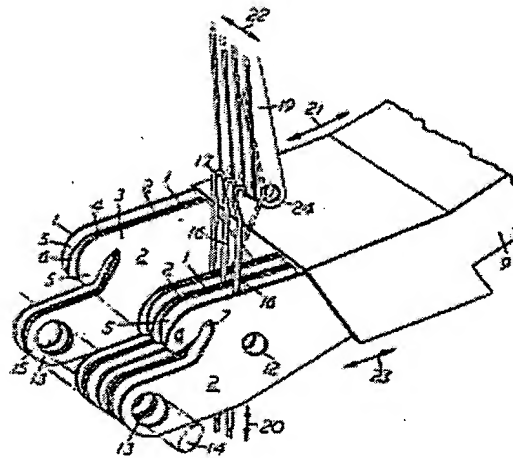


Fig. 3

